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MODULAR REVISION PROSTHESIS

Background of the Invention

[0001] In order to restore the function of a loose artificial hip joint, various major and minor problems have to be surmounted. The major problems are the anchorage problems related to achieving stable fixation despite often large defects remaining in the bony support after the joint components have been removed. Minor problems involve filling in the defects with bone from tissue banks; this is accomplished using "morcellized bone" plastics of the appropriate size. (Lamerigts, N. M. P., 1998. *Proefschrift an der katholischen Universität Niymegen.*) Once the bony support structure has been reinforced with bone from tissue banks, the corresponding joint replacement components can be cemented in.

[0002] In order to use such a procedure, the bony structures must be sufficiently stable to achieve a stable overall anchorage. However, these structures often are no longer present, and as a result, very special demands are placed on the implant. Therefore, there is a genuine need for systems that can be adapted to the given situation and that take various biomechanical fixation principles into account. With this background as a foundation, a novel approach to the problem of revision operations was unexpectedly discovered.

Prior Art

[0003] The extent of the defects in the bony femur bed after the removal of a loose prosthesis may vary. This has led to attempts to classify bone defects, for example in the DGOT (Bettin, D., Katthagen, B. D., (1997), Die DGOT-Klassifkation von Knochendefekten bei Hüft-Totalendoprothese-Revisionsoperationen [The DGOT Classification of Bone Defects in Total Hip Endoprosthesis Revision Operations], *Z. Orthop.* 135). In some cases, the bone damage is considerable. Treatment of the loose components involves complete removal of the components and, if present, the bone cement, as well as all of the connective tissue surrounding the implant. Not

until this has been done can one realistically assess the extent of bone loss. Often, the only way to anchor a new component is to reach beyond all defects and anchor the component deep in the portion of the femur diaphysis that is still healthy, frequently without the use of cement.

[0004] Another method is to reconstruct the bone with morcellized bone from tissue banks and use cement to reattach such a component. This is described in detail in Lamerigts, N. M., (1998), The Incorporative Process of Morcellized Bone Graft. Proefschrift University Nijmegen (Catholic University). In both cases, proximal anchoring is usually not stable. The implants are usually very long and heavy, and much poorer results are obtained than in primary operations.

[0005] Tests and simple experiments on cadaver bones unexpectedly revealed very efficient ways to anchor and fix femur components in defective bone support structures, even components having short shafts.

Description of the Invention

[0006] The modular tension anchorage system allows one to adapt the implant to various defect conditions encountered in revising a loose femur component. The invention takes various defects that have to be dealt with into account with regard to the stem or shaft length and various additional anchoring possibilities in the proximal femur canal. The modular system essentially is comprised of an axis (100), which corresponds to a cylinder located around the medullary canal axis.

[0007] Various segments must be used in sequence around this cylinder: the base segment (100.1) may be of various lengths, and it is always comprised of the tip (102) and the axial cylinder (103). One stem segment - in rare instances two or more stem segments (100.2 , 100.3) - may be arranged on top of each other above the axial cylinder . A base segment (100.1) always follows these stem segments. The contact surface (105) on the base segment is concave. The corresponding end of the center segment is convex , or vice versa . Both articulating ends may also engage one another conically . A curved, interlocking surface design has proved

to be particularly effective. Such a surface prevents rotation and takes tension loads on the lateral side and compression loads on the medial side into account.

[0008] The axial cylinder (103) and the corresponding hole are smooth, or they are structured with a locating groove and nubs to prevent rotation. The length of the prosthesis is determined based on how far it needs to extend beyond defects, and a center segment (100.2) is inserted through the hole (106) above the central axial cylinder (103). The cross section (108) of the stem consists of the lateral cylinder, which can also be hollow (109 and 112), the connecting segment (111), and the medial portion (110), and it forms the convex-concave (104) convex contour of the dorsal side. The channel of the tension anchor (thrust rod) passes through (113) extended areas of the medial portion.

[0009] The metaphysial segment exhibits a parabolically curved outer surface medially, ventrally, and dorsally in the U-shape of the force transfer. The shoulder (200) of the prosthesis has additional holes for tension anchors (60) and cables (71). The thrust anchor (50) is held in the cone of the prosthesis (300), which [verb missing: extends?] axially through the cone like a tension screw or, as shown, having a washer (54) and screw head (51) as well as a nut (55) that is prevented from turning. The other tension anchors can also be embodied as simple tension screws (for example 60), in which case the screw head would be located in the shoulder (200) and the tension screw thread would be located on the distal end of the bone.

[0010] The combination of tension anchor, tension screws, and cables allows the prosthesis parts to be fixed in a stable position, even in bone canals that have major defects.

Example

[0011] After making absolutely sure the diagnosis is loosening of the hip prosthesis, the joint is exposed via the old access. The scar tissue is carefully removed, the joint is dislocated, and the loose shaft is removed. Usually it can simply be pulled out; in rare case, an instrument needs to be

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used to hammer it out. The bone cement and connective tissue are then carefully removed. An ultrasonic titanium chisel can be very useful in this procedure.

[0012] The bone channel, from which the connective tissue has be removed, is rinsed carefully using a jet lavage, and the bony structure is then reconstructed; to do this, tissue bank bone is ground up in a mill, and this "morcellized" bone is mixed in a 50:50 ratio with a shell-shaped bone ceramic used as the granulate - for example: Synthacer® - and it is then forced up against the walls in the intermedullary canal with the aid of a trial shaft. Drainage tubes are then inserted via the fossa intertrochanterica, and a vacuum is applied to these drainage tubes. Then, the intermedullary tissue is carefully rinsed with H_2O_2 and filled with bone cement using a snorkel application system. The installed prosthesis is axially inserted into the bed, which is filled with bone cement and bone. After the cement has cured, a hole is drilled in the prosthesis in an axial position relative to the cone, and, if necessary, additional holes are drilled through it, and it is stably anchored in the bone of the proximal canal by means of tension anchors or tension screws. The screws can also be advantageously screwed in through the still-soft cement, provided that holes were drilled in advance in the bone. The advantage of this is that the bone cement shrinks onto the screw thread.

[0013] If conditions in the bone are still stable, the prosthesis system can also be anchored stably in the femur bone without using bone cement.